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MILITARY POTENTIAL TEST OF ARMY AIRCRAFT SPARK PLUGS, RHB-36P, --ETC(U)
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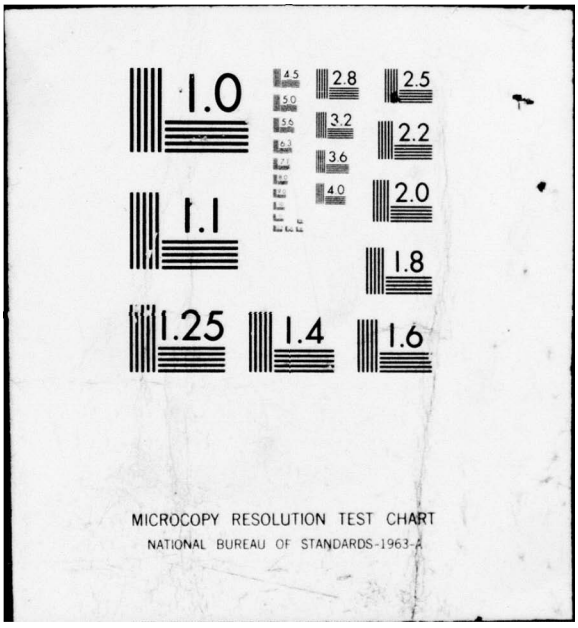
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NATIONAL BUREAU OF STANDARDS-1963-A

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36362

STEBG-TD

30 NOV 65

SUBJECT: Letter Report of Military Potential Test of Army Aircraft Spark Plugs, RHB-36P, FSN 2525-801-8456, USATECOM Project No. 4-5-5408-01

TO: Commanding General
US Army Aviation Materiel Command
ATTN: SMOSM-EERG
12th and Spruce Streets
St. Louis, Missouri 63166

USATECOM-4-5-5408-01

1. References.

a. MIL-S-7886/1002 (MO), "Military Specification Spark Plugs: Shielded Fine Wire Platinum Electrode, Type I for Aircraft Reciprocating Engines," 23 October 1963.

b. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 18 August 1964, subject: "Test Directive, USATECOM Project No. 4-5-5408-01, Military Potential Test of Army Aircraft Spark Plugs AC-281, FSN 2525-801-8456."

c. Letter, SMOSM-EERG, Headquarters, US Army Aviation Materiel Command, 11 January 1965, subject: "Plan of Test for Spark Plugs for OH-13S Aircraft."

2. Authority.

a. Directive.

Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 18 August 1964, subject: "Test Directive

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SUBJECT: Letter Report of Military Potential Test of Army Aircraft Spark Plugs, RHB-36P, FSN 2525-801-8456, USATECOM Project No. 4-5-5408-01

USATECOM Project No. 4-5-5408-01, Military Potential Test of Army Aircraft Spark Plugs, RHB-36P, FSN 2525-801-8456."

b. Purpose. The purpose was to determine suitability and reliability of the RHB-36P Spark Plugs when used in the OH-13S Helicopter.

3. Objectives. To determine:

a. Capability of the test spark plugs to operate satisfactorily for four hundred flight hours when installed in the 0-435-25 engine in the OH-13S Helicopter.

b. Condition of the spark plugs at test completion or when failure or malfunction occurs.

4. Description of Materiel.

a. RHB-36P Spark Plug. The RHB-36P is a shielded, fine wire, platinum electrode, Type I spark plug. The test spark plugs are currently in the Army supply system and have been assigned a Federal Stock Number (FSN).

b. 0-435-25 Engine. The 0-435-25 installed in the OH-13S is a 260-brake horsepower (b.hp.) turbocharged engine with a derated operating limit of 220 b.hp. at 3200 revolutions per minute (r.p.m.). The engine is a six-cylinder, horizontally-opposed, dry-sump, forced-air-fan-cooled, vertically-installed, internal combustion aircraft engine with a single-barrel, float-type carburetor.

5. Background.

a. Requirement. US Army Aviation Materiel Command (USAAVCOM) has established a comprehensive program of qualifying spark plugs for a number of aircraft-engine combinations to ease the management of the overall spark plug program and broaden the procurement base.

b. Spark Plug Test Program. A series of flight tests have been conducted by the US Army Aviation Test Board (USAAVNTBD) under the sponsorship of USAAVCOM to qualify additional spark plugs for each aircraft-engine combination. This test was one of the series.

c. MIL-S-7886/1002 (MO). Military Specification 7886/1002 (MO) was published to establish qualification criteria for Type I, fine-wire, platinum electrode spark plugs. The test directive specifies that suitability and reliability of the spark plugs will be determined by their conformance to the requirements set forth in MIL-S-7886/1002.

d. Criteria. The objectives of this test program have been specifically selected and oriented to answer those requirements generated by MIL-S-7886/1002 (MO) (inclosure 1) which is the basic criteria for the conduct of this test. Permission was granted by USAAVCOM to deviate from paragraph 4.3.1.1.2 of the Military Specification permitting a climb to 10,000 feet pressure altitude rather than "aircraft maximum operating altitude" as specified.

6. Findings. Military potential testing of RHB-36P Spark Plugs in an 0-435-25 engine installed in OH-13S Helicopter, serial number 62-9073, was conducted from 1 March 1965 through 21 October 1965. A total of 237.5 operating hours was accomplished in the vicinity of Fort Rucker, Alabama. Throughout the test period, a record of spark-plug malfunctions and failures to include hours attained, cause of failure, and cylinder location where each spark plug was installed was maintained. All test plugs were photographed, inspected, and tested at termination of the test, or when failure or malfunctioning occurred. The condition of each spark plug with respect to carbon deposits, oil deposits, lead deposits, bridged electrodes, electrode deterioration, gap growth, flash-over conditions, the existence of cracked insulator tips and bonds was noted.

a. Two of the test spark plugs failed at 148.5 engine operating hours. They were installed at the number one cylinder rear and the number six cylinder front. The cause of failure was lead fouling (see figure 1).

b. An ignition analyzer check at 213.5 engine operating hours indicated that the spark plugs in number six cylinder rear and number four cylinder front were malfunctioning. These spark plugs were removed and inspected in accordance with paragraph 4.3.1.1 of the Military Specification, and reinstalled.

c. At 237.5 engine operating hours, the engine developed a right magneto drop of 250 r.p.m. An ignition analyzer check indicated the spark plugs were firing satisfactorily. The electrical system was checked and found to be satisfactory. All spark plugs were removed and inspected in accordance with MIL-S-7886/1002. The tester indicated that three of these spark plugs were firing intermittently. The spark plug electrode gaps at 237.5 engine operating hours were as follows. (Prior to initial installation, the gaps were set at 0.016 inch.)

No. 1 Cylinder

Front - 0.022 inch; rear - 0.021 inch

No. 2 Cylinder

Front - 0.022 inch; rear - 0.023 inch

No. 3 Cylinder

Front - 0.023 inch; rear - 0.023 inch

No. 4 Cylinder

Front - 0.018 inch; rear - 0.023 inch

No. 5 Cylinder

Front - 0.023 inch; rear - 0.023 inch

No. 6 Cylinder

Front - 0.020 inch; rear - 0.023 inch

Visual inspection revealed that the electrode had worn on both sides of the points causing erratic operation (see figure 3).

d. The test was terminated at 237.5 engine operating hours because the spark plugs exceeded the failure rate specified in MIL-S-7886/1002 (MO). The condition of the spark plugs at that time is shown in figure 2.

e. The condition of the two spark plugs that failed because of lead deposit (see paragraph 6a) is shown in figure 1.

f. The condition of the malfunctioning spark plugs (see paragraph 6c) is shown in figure 2.

7. Conclusions.

a. The test spark plugs failed to meet the Military Specification, MIL-S-7886/1002 (MO).

b. The RHB-36P Spark Plugs did not qualify for 400 operational hours in 0-435-25 Engine/OH-13S Helicopter combination.

8. Recommendation. It is recommended that no further testing be conducted on the RHB-36P Spark Plugs.

2 Incl
1. MIL-S-7886/1002 (MO)
2. Photographs

RAYMOND E. JOHNSON
Colonel, Artillery
President

Distribution:
(see page 6)

Distribution (continued)

Commanding General — 2 copies
US Army Test and Evaluation Command
ATTN: AMSTE-BG
Aberdeen Proving Ground, Maryland 21005

Commandant — 1 copy
US Army Aviation School
Fort Rucker, Alabama 36362

MIL-S-7886/1002 (MO)

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MILITARY SPECIFICATION

SPARK PLUGS: SHIELDED, FINE WIRE PLATINUM ELECTRODE, TYPE 1 FOR AIRCRAFT RECIPROCATING ENGINES

1. SCOPE

1.1. This specification covers type 1, fine wire platinum electrode spark plug for:

Aircraft	Using engine
UH-19D	R-1300-3
CH-21C	R-1820-103
CH-34	R-1820-84
CH-37	R-2800-54
CV-2	R-2000-7M2
OH-13S	O-435-25

2. APPLICABLE DOCUMENTS

2.1. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

P-2-661	Solvent, Dry-Cleaning

MILITARY

MIL-O-6081	Oil, Lubricating, Jet Engine
MIL-S-7886	Spark Plug, Shielded, Aircraft Reciprocating Engine, General Specification for

Encl 1

STANDARD

ARMY-NAVY AERONAUTICAL

AN4027 Gasket--Spark Plug

(Copies of specifications and standard required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1. Qualification. -- Spark plug shall be a product which has passed the qualification tests in accordance with Specification MIL-S-7886; which has been listed, or approved for listing, on the applicable qualified products list for the engine-airframe combination specified in table I; and which is in compliance with this specification.

3.2. Performance reliability. -- Spark plug shall be capable of operating satisfactorily without fouling or other evidence of electrical or mechanical failure when subjected to the flight tests specified in 4.2.

4. QUALITY ASSURANCE PROVISIONS

4.1. Test conditions. --

4.1.1. Engine. -- Only an engine in proper mechanical and electrical condition, having sufficient time before the next overhaul for the flight test involved, shall be used for the testing of the spark plugs. Bushing threads in the cylinder shall be cleaned of carbon and other foreign matter. The maintenance inspection of the engine shall also include a check on (1) the compression and (2) the ignition components including coils breaker points, condenser, ignition harness, distributor, and magneto timing.

4.1.2. Identification of plugs. -- Prior to installation of each complete set of test plugs, of the same part number, each plug shall be permanently marked by etching to indicate cylinder number and position.

4.1.3. Gasket. -- Whenever a plug is installed, a new gasket conforming to Standard AN 4027 shall be used.

4.1.4. Torque. -- Plugs shall be tightened to the torque specified for the test condition, preferably to the high limits, as specified in Specification MIL-S-7886.

4.1.5. Lubrication. -- Whenever a plug is removed for inspection, the threads shall be lubricated with engine oil conforming to grade 1010 of Specification MIL-O-6081, prior to its reinstallation.

4.2. Tests. -- Spark plugs shall be tested under controlled, and under other than controlled, flight conditions, as specified below. Engine-airframe combinations, fuel, electrode gap, flight hours, and allowable number of spark plug failures for each engine, shall be as specified in table I.

TABLE 1. -- Engine-airframe combinations.

Engine	Aircraft	Fuel	Electrode gap (inch)	Flight hours	Plug failures per engine
R-1300-3	UH-19D	115/145	.015/.018	400	3
R-1820-103	CH-21C	115/145	.015/.018	400	4
R-1820-84	CH-34	115/145	.015/.018	400	4
R-2800-54	CH-37	115/145	.015/.018	400	8
R-2000-7M2	CV-2	115/145	.015/.018	400	6
O-435-25	OH-13S	115/145	.015/.018	400	3

4.2.1. Controlled flight. -- At the beginning of the controlled flight tests, and at approximately every 100 hours of flight time thereafter, the following three tests, for both rotary wing and fixed wing, shall be successfully accomplished three times:

4.2.1.1. Rotary wing. --

4.2.1.1.1. Lifting and hovering capability. -- Engine shall be allowed to idle in auto rich for 15 minutes, using normal defouling procedures. Engine shall then be capable of lifting and hovering the craft with its maximum military load until highest permissible engine cylinder head temperature is reached.

4.2.1.1.2. Maximum rate of climb and power. -- After engine cools to normal operating temperature, it shall be capable of taking off and maintaining maximum rate of climb to the aircraft maximum operating altitude, followed by a 15-minute cruise at low power to cool and stabilize engine temperatures, then a level course maintained at maximum except takeoff (METO) for 5 minutes, followed by maximum endurance power for 30 minutes.

4.2.1.1.3. Cruise power and autorotation. -- Engine shall be cruised at low power for 15 minutes, cool the engine, and autorotated to a safe recovery altitude, followed by level flight at cruise power for 30 minutes.

4.2.1.2. Fixed wing. --

4.2.1.2.1. Maximum rate of climb with maximum military load. -- Engine shall be allowed to idle in auto rich for 15 minutes, using normal defouling procedures. Engine shall then be capable of maintaining maximum rate of climb with maximum military load from point of takeoff to the aircraft maximum operating altitude.

4.2.1.2.2. Cruise and maximum endurance power. -- The engine shall then be operated for 15 minutes at approximately 65-percent power in cruise to cool and stabilize engine temperatures, followed by maximum except takeoff (METO) power for 5 minutes, and then at maximum endurance power for 30 minutes.

4.2.1.2.3. Cruise, glide, and level flight. -- Then cruise shall be at approximately 65-percent power for another 15 minutes to cool the engine, followed by a 2-minute glide at 20 percent power, and again at approximately 65-percent power in level flight for 15 minutes.

4.2.2. Other than controlled flight. -- Flight time other than controlled shall be under normal service conditions and in accordance with applicable technical data relating to performance of typical maneuvers normally associated with observation, resupply, communication relay, and similar type missions.

4.3. Inspections. --

4.3.1. Intervals. -- Plugs shall be tested without their removal by using an ignition analyzer at 50, 100, 150, 200, 250, 300, 350, and 400 hours, to determine whether the plugs in each cylinder function properly.

4.3.1.1. Malfunctioning plugs. -- Any plug showing indication of malfunctioning shall be removed from the engine and visually inspected. If oil-fouled, it shall be cleaned by soaking the firing and cavity for 30 minutes in solvent conforming to Specification P-S-661 and draining and drying it thoroughly with a filtered airblast. A light abrasive-blast cleaning is permissible if necessary to remove hardened oil deposits. In addition, the ceramic shielding barrel shall be thoroughly cleaned. The electrode gaps shall be measured with a round wire gage. (Plugs shall not be regapped.) Plug shall be placed in a spark plug tested such as the AV 18-1 manufactured by AC Spark Plug Div. of General Motors Corp., or equivalent. Tester shall be connected to a single-phase 110-120 volt. 60-cycle power supply outlet. Nitrogen gas shall be used in the pressure chamber: for spark plug electrode gaps under .020-inch, 200 psi; for gaps over .020-inch, 175 psi. If plug fires under these conditions, it should be reinstalled in same position in the engine, using a new gasket conforming to Standard AN4027.

4.3.1.2. Plug failures. -- Plugs other than oil-fouled, or showing obvious mechanical failure, shall be tested in a spark plug tester (see 4.3.1.1). Any plug failing to fire shall be considered a failed plug. Plug failures due to other than normal flight test conditions are not to be considered plug failures and shall be replaced with like new items. Cracked ceramic insulators, electrode failures, chromic fuel and lead fouling, or other bonafide failures are considered plug failures.

4.3.2. Final examination. -- At the completion of 400 flight hours, plugs shall be removed from the engine and given final inspection. This shall include visual inspection, final gap measurement, and testing in spark plug tester as specified in 4.3.1.1. Results of these inspections shall be shown on test report indicating the performance of each set of spark plugs under tests and examinations specified herein.

4.4. Test stoppage. -- If more than the allowable number of plug failures occurs before completion of flight hours scheduled (see table I), test shall be stopped.

5. PREPARATION FOR DELIVERY

5.1. Preparation for delivery shall be in accordance with section 5 of Specification MIL-S-7886.

6. NOTES

6.1. Intended use. -- Type 1 spark plug is intended for use with the engine-airframe combinations specified in 4.2.

6.2. Ordering data. -- Ordering data shall be in accordance with Specification MIL-S-7886.

6.3. Qualification. -- With respect to products requiring qualification, awards will be made only for such products as have, prior to the bid opening date, been tested and approved for inclusion in the applicable qualified products list, whether or not such products have actually been listed thereon by that date. The attention of suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification in order to be eligible to be awarded contracts or orders for the product covered by this specification. The activity responsible for the qualified products list is the U. S. Army Mobility Command, Warren, Michigan; however, information pertaining to qualification of products may be obtained from the Commanding General, U. S. Army Aviation and Surface Materiel Command, ATTN: Directorate of Engineering, P. O. Box 209, Main Office, St Louis, Missouri 63166

PHOTOGRAPHS

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